Guest Editorial: Incubators and Accelerators: Integrating Evolving Incubator Models and Learning from the Past

I. Introduction

MANAGEMENT and organizational science focusing on the complex process of R&D that leads to the subsequent commercialization has come a long way since the days of post-World War II industrial and research laboratories. In this context, the evolution of the incubator can be retraced from the foundational research in the 1950s and 1960s of Research-on-Research—that explored the R&D process in a number of settings to derive and test theories of organization behavior [1]. Since then, we have seen a concentration of research and practice that have spanned a burgeoning range of incubators models and entities that, in some manner, exist to play a role to support and harness new technology-based start-ups. For more than half a century, these third-party entities in the entrepreneurial ecosystem have spread from the United States to Europe and are a well-established worldwide phenomenon. Business incubators have been largely viewed as an essential means to facilitating the process of knowledge transfer and tech-based commercialization through the provision of office infrastructure, laboratories and equipment, business support services, mentoring, and access to entrepreneurial finance and specialist networks for the founders of these embryonic start-ups [2]–[6].

The heterogeneity of incubator models has been well acknowledged by a multitude of researchers [7]–[9] and this has been further compounded with the diffusion of similar third-party entities that aim to act as innovation intermediaries including science parks, research parks, technology business incubators, university incubators and innovation centers. This multitude of terms has pervaded the academic literature, yet, often many of these entities provide the same or very similar services, which raises the question if they have transgressed into overly compartmentalized entities and, thus, further fragmenting the incubation literature? This suggests that the incubation literature itself still has some way to go to reach the ambidextrous state of illuminating the heterogeneity of incubator models, while at the same time organizing the definitional parameters of similar incubator models to help facilitate comparative and generalized understanding that will be of increasing value to practitioners and policy makers. The challenge is further sharpened with the evolution of the accelerator model.

One of the pioneers of incubation field, Ed. Roberts, offered a critique of the, then fledging R&D management field, inter alia, pointed out that management research had emphasized *pieces* rather than the *process* of R&D [10]. If we reflect on the evolution of the incubator research field, many researchers echoed Roberts' earlier advice. Namely, the incubator field was initially, largely sustained by configurational-orientated studies (i.e., studies of inputs and outputs) but there was a dearth of process-orientated studies that will go inside the *"black box"* of complex processes with incubators to help shed light on how they support and add value to embryonic projects and start-ups. From the mid-2000s, there were more concerted efforts by researchers to conduct more process-driven studies that helped shed light on the "black box" of value-added incubation processes and what this meant for the optimization of management practices and critical resources and capabilities, to help nurture embryonic start-ups? Increasingly, researchers unveiled the networked incubator [9] and the critical capabilities of incubators to interact and leverage critical resources from their entrepreneurial ecosystem.

Moreover, in the entrepreneurial ecosystem, the role of users is inherently more pervasive in the trajectory of high-tech starts. Users and user communities are increasingly immersed in the transitioning of high-tech projects and embryonic start-ups, and often as a result of technology platform-based business models or hyperconnected Internet-enabled products and services. The rapid development of information communication technologies changes the range and speed of access to technology and information [11], and thus, significantly alters the way business incubators access technology and pursue innovation [5]. The interplay of users (and user communities), policy, and connected technologies suggest that ecosystem stakeholders are more convergent in today's incubators settings that at any other time.

In this Special Issue, we attempt to advance discussion on the heterogeneity of business incubators, specialized incubator support and entrepreneurial cognition, and a contextual understanding of the interaction of incubators and their tenant spin-offs and their entrepreneurial ecosystem. In the rest of this introductory article, we introduce the key findings of the eight accepted papers that contribute to our understanding of incubator heterogeneity, specialized support, entrepreneurial cognition, and the entrepreneurial ecosystem.

II. Heterogeneity of Business Incubators

Despite the lack of an agreed definition amongst scholars of what exactly constitutes a business incubator (BI), the term itself has become an accepted neologism amongst academics,

Date of current version June 8, 2022.
Digital Object Identifier 10.1109/TEM.2022.3167953

TABLE I
SUGGESTIONS FOR FUTURE RESEARCH (AYYASH *ET AL.*)

Table 1 – Suggestions for Future Research (Ayyash et. al)		
Theme/Sub theme	**Research questions**	**Possible theory/lens**
The BI model		
Selection criteria	How does the BI make its choices among the applicants?	Decision making theory
Process of BI: building management team	How does the incubated venture's top management team change and develop during the phases of incubation?	Process theory
Process of BI: knowledge acquisition	How do the incubated firms acquire knowledge from different training programs of different BIs models?	Configurational theory
Process of BI: securing venture capital	How does the incubated venture find, and make a decision on, investors?	Transaction cost theory
Mediation	How does the BI leverage external interactions?	Open systems theory
Graduation	To what extent do BI achieve their goals?	Effectiveness theory
The purpose of BI	The role and influence of different formal and informal structures on BI performance?	Market orientation/organizational performance
The target of BI support (organizational boundaries)	What are the causes of incubated venture's growth? What are the factors that leads to limiting BI rate of growth?	Market orientation/organizational performance

policy makers and practitioners (Ayyash *et al.*, [A1]). In their systematic literature review that encompasses both academic and practitioner literature, Ayyash *et al.* find that definitions of BIs are constructed around three core themes: 1) the BI model; 2) the purpose of the incubator; and 3) the target of support provided by the incubator. Moreover, the authors provided an expansive research agenda with suggested research questions and possible theoretical approaches to explore the three core themes of their BI definitions (see Table I).

Ayyash *et al.* argued that clearer BI definitions will help practitioners with regard to the "blurring" that surrounds the BI concept and will facilitate a shared understanding of BI, which, in turn, may ease the development of performance measures, evaluation performance, and identifying best practices. For researchers, a clear definition of BI will help the development of the research domain and improve researchers' ability to conduct comparative research of incubators.

III. DYNAMIC SUPPORT AND ENTREPRENEURIAL COGNITION OF EMBRYONIC START-UPS

Specialized support facilitates high-tech academic spin-offs to navigate various barriers and critical junctures during their growth stages. In a qualitative study of university spin-offs (USOs) in The Netherlands, Khodaei *et al.* [A2] found that USOs appreciate milestones and direct interface regarding business support, business plan development and legal support during early growth stages. In all stages, but in particular later stages, founders valued networked support and related to this they reported a low usage of the incubator resources. This adds credence to the value of a networked approach and leveraging an incubators entrepreneurial ecosystem.

The emerging stream of situated entrepreneurial cognition asserts that the environment substantially influences the inherent knowledge structures of entrepreneurial reasoning. It claims that the context indoctrinates the perceptions and beliefs underlying decision-making, thus authoring entrepreneurial cognition to derive from the recursive interaction between mind and the respective environment (Roessler *et al.* [A3]). Drawing on this perspective, Roessler *et al.*, in their episodic interviews with entrepreneurs in corporate incubators and accelerators in Germany, found that entrepreneurial cognition is embedded, grounded, and distributed, and results from the recursive interplay of material objects, bodily interactions, and agents spanning a social system. In addition, it was found that the business model is the central boundary object connecting and focalizing a variety of influences on the situated entrepreneurial cognition in its social context. Zarei *et al.* [A4] utilized a game-theoretic approach to the selection, mentorship, and investment decisions of start-up accelerators. In this approach, they study the mutual effects between an accelerator, a venture capitalist, and start-ups. Key findings from this study were that the most vital role of an accelerator is its screening services, this was followed by mentorship, and seed investment services.

IV. LEVERAGING THE ENTREPRENEURIAL ECOSYSTEM

There is a lack of research illustrating the impact pre-market support mechanisms can have on pre-market USO development and their strategic outcomes such as timing of the USOs first

market entry. Messina *et al.* [A5] found in a study of Italian USOs that both university environment and ecosystem actors leave lasting positive and negative imprints upon USO founders. Interestingly, USO founders who had positive engagement with university ecosystem actors and perceived their university environment as supportive, developed entrepreneurial skills, and market knowledge earlier in the USO formation process.

Extant literature indicates that successful ecosystems require a balance between cooperation and competition to maintain the improvement of value creation; little evidence exists of the effects on performance. Theodoraki *et al.* [A6], in a survey of 156 incubators in France, aimed to test the effects of the entrepreneurial ecosystem and co-opetition strategy and incubator performance. Their findings revealed that co-opetition significantly improves incubator performance and the entrepreneurial ecosystem has a moderating role between the incubator strategy and performance. It is suggested that policy makers may favor hybrid strategies such as co-opetition over pure strategies such as cooperation or competition under certain conditions.

In a multicase study of accelerator and incubator programs in Greater London, U.K., Cuvero *et al.* [A7] aimed to identify the types of knowledge spillovers that affect entrepreneurs in the early stages of start-up development. The findings suggest that entrepreneurs are influenced by various forms of knowledge spillover, which assist in determining the strategic direction of the company, in terms of formation, including partnerships or alliances, allocation of R&D budgets, and engagement in product innovation. Significantly, it was found that start-ups use various technological platforms to access knowledge spillovers, which challenges the ideas of geographical proximity present in existing knowledge spillover theory understanding.

Finally, Neumeyer [A8] examined the role of individual and team-level factors in promoting female entrepreneur's participation in accelerator and incubator programs. Using data collected from 65 teams enrolled in a team-based entrepreneurship program run by a university in the U.S Midwest region, results indicated that female students are less likely to participate in an incubator or accelerator program than their male counterparts. It was also found that a higher proportion of women in a team was positively related to women's subsequent entrepreneurial actions, namely joining an accelerator or incubator program.

BRENDAN GALBRAITH, *Guest Editor*
Department of Marketing
Zayed University
Abu Dhabi, UAE

RODNEY MCADAM, *Guest Editor*
Department of Management, Leadership and Marketing
University of Ulster
Belfast, U.K.

STEPHEN EDWARD CROSS, *Guest Editor*
Stewart School of Industrial and Systems Engineering
Georgia Institute of Technology
Atlanta, GA USA

APPENDIX: RELATED ARTICLES

[A1] S. A. Ayyash, M. McAdam, and C. O'Gorman, "Towards a new perspective on the heterogeneity of business incubator-incubation definitions," *IEEE Trans. Eng. Manage.*, vol. 69, no. 4, Aug. 2022.

[A2] H. Khodaei, V. E. Scholten, E. F. M. Wubben, and S. W. F. (Onno) Omta, "The role of academic spin-offs facilitators in navigation of the early growth stage critical junctures," *IEEE Trans. Eng. Manage.*, vol. 69, no. 4, Aug. 2022.

[A3] M. Roessler, D. Schneckenberg, and V. K. Velamuri, "Situated entrepreneurial cognition in corporate incubators and accelerators: The business model as a boundary object," *IEEE Trans. Eng. Manage.*, vol. 69, no. 4, Aug. 2022.

[A4] H. Zarei, M. Rasti-Barzoki, and I. Moon, A Game, "Theoretic approach to the selection, mentorship, and investment decisions of start-up accelerators," *IEEE Trans. Eng. Manage.*, vol. 69, no. 4, Aug. 2022.

[A5] L. Messina, K. Miller, and N. Hewitt-Dundas, "USO imprinting and market entry timing: Exploring the influence of university ecosystems," *IEEE Trans. Eng. Manage.*, vol. 69, no. 4, Aug. 2022.

[A6] C. Theodoraki, K. Messeghem, and D. B. Audretsch, "The effectiveness of incubators' co-opetition strategy in the entrepreneurial ecosystem: Empirical evidence from france," *IEEE Trans. Eng. Manage.*, vol. 69, no. 4, Aug. 2022.

[A7] M. Cuvero, M. L. Granados, A. Pilkington, and R. D. Evans, "The effects of knowledge spillovers and accelerator programs on the product innovation of high-tech start-Ups: A multiple case study," *IEEE Trans. Eng. Manage.*, vol. 69, no. 4, Aug. 2022.

[A8] X. Neumeyer, "Inclusive high-growth entrepreneurial ecosystems: Fostering female entrepreneurs' participation in incubator and accelerator programs," *IEEE Trans. Eng. Manage.*, vol. 69, no. 4, Aug. 2022.

REFERENCES

[1] B. Galbraith, R. McAdam, S. E. Cross, "The evolution of the incubator: Past, present and future," *IEEE Trans. Eng. Manage*., vol. 68, no. 1, pp. 265–271, Feb. 2021.

[2] R. McAdam, W. Keogh, B. Galbraith, D. Laurie, "Defining and improving technology transfer business and management processes in university innovation centres," *Technovation,* vol. 25, no. 12, pp. 1418–1429, 2005.

[3] W. Lamine, S. Mian, A. Fayolle, M. Wright, M. Klofsten, and H. Etzkowitz, "Technology business incubation mechanisms and sustainable regional development," *J. Technol. Transfer*, vol. 43, no. 5, pp. 1121–1141, 2018.

[4] B. S. M. Hillemane, K. Satyanarayana, and D. Chandrashekar, "Technology business incubation for start-up generation," *In. J. Entrepreneurial Behav. Res.*, vol. 25, no. 7, pp. 1471–1493, 2019.

[5] Z. Wang, Q. He, S. Xia, D. Sarpong, A. Xiong, and G. Maas, "Capabilities of business incubator and regional innovation performance," *Technological Forecasting Social Change*, vol. 158, 2020, Art. no. 120125.

[6] L. Messina, K. Miller, B. Galbraith, and N. Hewitt-Dundas, "A recipe for USO success? Unravelling the microfoundations of dynamic capability building to overcome critical junctures," *Technological Forecasting Social Change*, vol. 174, 2022, Art. no. 121257, doi: 10.1016/j.techfore.2021.121257.

[7] P. Clayton, M. Feldman, and N. Lowe, "Behind the scenes: Intermediary organizations that facilitate science commercialization through entrepreneurship," *Acad. Manage. Perspectives*, vol. 32, no. 1, pp. 104–124, 2018.
[8] S. Mian, W. Lamine, and A. Fayolle, "Technology business incubation: An overview of the state of knowledge," *Technovation*, vol. 50–51, pp. 1–12, 2016, doi: 10.1016/j.technovation.2016.02.005.
[9] A. Bøllingtoft, "The bottom-up business incubator: Leverage to networking and cooperation practices in a self-generated, entrepreneurial-enabled environment," *Technovation*, vol. 32, no. 5, pp. 304–315, 2012.
[10] E. B. Roberts, "Toward a new theory for research and development," *Ind. Manage. Rev.*, vol. 4, no. 1, pp. 29–40, Fall 1962.
[11] M. A. Lema *et al.*, "Business case and technology analysis for 5G low latency applications," *IEEE Access*, vol. 5, pp. 5917–5935, 2017.

Brendan Galbraith (Member, IEEE) received the B.A.(Hons.) degree in hospitality management, the M.S. degree in business studies, and the Ph.D. degree in innovation and entrepreneurship from Ulster University, Newtownabbey, County Antrim, U.K., in 2003, 2004, and 2014, respectively.

He is currently an Associate Professor in Entrepreneurship with Zayed University, Abu Dhabi, UAE. He has authored or coauthored in a range of international journals including *Entrepreneurship and Regional Development*, *Technovation*, *R&D Management*, *Technology Analysis and Strategic Management*, and *International Journal of Production and Operations Management*. He has coauthored and coedited two books on innovation intermediaries and social innovation.

Dr. Galbraith is a board member of the IEEE Technology Management Society.

Rodney McAdam received the B.Sc.(Hons.) and Ph.D. degrees in engineering from Queens University Belfast, Belfast, U.K., in 1980 and 1983, respectively, the M.A. degree in management learning from Lancaster University, Lancashire, U.K., in 1998, and the Ph.D. degree in management from Ulster University, Newtownabbey, County Antrim, U.K., in 2002.

He is currently a Professor of Innovation Management with the Ulster University Business School, Belfast, U.K. He has authored or coauthored more than 200 journal papers in a range of international journals including the *International Journal of Production Economics*, *Entrepreneurship and Regional Development*, *Technovation*, *R&D Management*, *Technology Analysis and Strategic Management*, and *International Journal of Production and Operations Management*.

Stephen Edward Cross (Life Fellow, IEEE) received the B.S.E.E degree from the University of Cincinnati, Cincinnati, OH, USA, in 1974, and the M.S.E.E degree from the Air Force Institute of Technology, Wright-Patterson AFB, OH, USA, in 1977, and the Ph.D. degree from the University of Illinois at Urbana Champaign, IL, USA, in 1983, all in electrical engineering.

He is currently an Adjunct Professor in Industrial and Systems Engineering with the Georgia Institute of Technology, Atlanta, GA, USA, where he was previously the Executive Vice President for Research. He has authored or coauthored widely on topics spanning innovation ecosystems, leadership, organizational development, technology transition, software engineering, and machine intelligence.

Dr. Cross is a past Editor-in-Chief of the IEEE INTELLIGENT SYSTEMS and was on the Executive Committee of the IEEE TECHNOLOGY AND ENGINEERING MANAGEMENT SOCIETY.